Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Peggy W Lehman

Final Selection Panel Review

Proposal Title

#0122: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Funding:

Fund in part
Amount: **$500,000**

The final Selection Panel concurred with its initial findings on this proposal. Due to the reduction in funds available for the Science Program's 2004 PSP, the Selection Panel recommended funding for this proposal be reduced to a recommended amount of $500,000. Should the California Bay−Delta Authority accept the Selection Panel's recommendation and approve the funding of this proposal, the applicant will be allowed to negotiate which tasks and associated costs will be reduced as part of the contracting process.

Public Comments

No public comments were received for this proposal.

Initial Selection Panel Review

Proposal Title

#0122: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Funding:

Fund
Amount: **$602,914**

Initial Selection Panel (Primary) Review

Topic Areas

- Environmental Influences On Key Species And Ecosystems
- Relative Stresses On Key Fish Species
- Processes Controlling Delta Water Quality

Please describe the relevance and strategic importance of this proposal in the context of this PSP. How does the proposal address the topic areas identified above? What are the broader CALFED Goals this proposal may meet that are not accounted for in these specific topic areas?

Proposal No. 122 Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta The Technical Panel rated this proposal 'superior' and the Collaboration Panel rating was 'adequate.' The proposal requests $600,000 over three years to determine the factors responsible for the conspicuous Microcystis blooms that have been observed in the Delta every summer since 1999 or so. Microcystsis is a common cyanobacteria that during severe blooms can render water toxic to fish, livestock and people. Blooms are also unsightly, interfere with water recreation and can adversely affect the food supplies of fish. Just how abundant and toxic Delta blooms are or might become is one of the many questions this project would attempt to

address. More importantly, the proposal also seeks to answer the questions: 'What is the best way to sample and monitor the bloom? and 'How could the bloom be controlled or reduced?'

The budgets of proposals submitted in response to this PSP are larger, on average, than those submitted to CALFED in previous years. The Science Program is committed to getting as much science per dollar as is reasonably possible. With this commitment in mind, can the proposed budget be streamlined? If so, please recommend and clearly justify a new budget total in the space provided.

I agree with the Technical Panel that this proposal was well prepared and merits further consideration for funding. One shortcoming of the proposal is that the study design for field data collection does not explicitly include any hydraulic variables (just habitat class, water quality variables and biological variables). Could some not-too-cumbersome method of estimating water velocity be added to the list? Another weakness is that it does not seem to include any sampling for Microcystis in the aqueduct-reservoir system south of the delta [Note: Jeff Janick at DWR and Rich Losee at MWD have >15 years of phytoplankton counts for several aqueduct and reservoir stations]. Finally, one of the most intriguing aspects of this study is unmentioned; namely, the possibility that whatever caused Microcystis to start blooming in the Delta is the same thing responsible for the contemporaneously steep declines of four Delta fish populations.

Evaluation Summary And Rating.

Provide a brief explanation of your summary rating and any additional comments you feel are pertinent.

Selection Panel (Discussion) Review

fund this amount: $**602,914**
note:
fund

The Panel felt that the proposed research is practical and relevant to CALFED. The proposal addresses a stressor that

potentially causes pelagic fish decline.

Literature review is being pursued by the California EPA. Monitoring work by DWR has looked at the question of 'where is it.' Interactions and overlap with species of concern has not yet been investigated in the Bay–Delta system.

This work is potentially useful, but should be modified. The authors should obtain existing MWD and DWR phytoplankton sampling records from south–of–Delta aqueduct reservoirs. They should also add explicit hypotheses about the relationship between microcystis and recent pelagic fish declines, especially whether both phenomenon may share the same underlying cause.

Lack of attention to hydraulic variables and salinity was seen as a potential short coming from a management perspective.

Panel Ranking: Fund with modifications – additional hypotheses as described above.

Collaboration Panel Review

Proposal Title

#0122: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Final Panel Rating
adequate

Collaboration Panel (Primary) Review

Collaboration:

Will the results of the collaborative effort be greater than the sum of its parts? Is it clear why the subprojects are part of a larger collaborative proposal rather than several independent smaller ones?

adequate
This project will be a collaborative effort between the CA Department of Water Resources, State University of New York, California EPA Office of Environmental Health Hazard Assessment and University of California at Davis.

Interdependence And Integration:

Does the proposal have an example that clearly articulates the conceptual model of each subproject and how they link together as a whole? Are the boundaries of the study plans focused and cohesive, yet well delineated? Is there a plan for potential differences in the stages of subproject completion times? Are there clear plans for analyses and interpretations which seek to identify and quantify relationships among the data collected in various subprojects rather than separate analyses for each subproject?

adequate
The interdependence is based on expected needs for carrying out research. (Literature review, data collection and analysis, written report.) The integration spans institutional boundaries. This is the upshot of the collaboration.

Project Management:

Is it clear who will be performing management tasks and administration of the project? Are there resources set aside for project management and time given for investigators to collaborate? Is there a process for making decisions during the course of the project? Are there acknowledgments of potential barriers to collaboration and explanations of how team members will overcome barriers particular to their institutions?

inadequate
"Dr. P. Lehman will be the principal investigator and will facilitate completion of an integrated conceptual model and final technical report, compile progress updates and coordinate information exchange with other principal investigators. CA Department of Water Resources will administer the contracts." No resources identified or funds set aside for meetings. No indication of decision−making process. No explanations or mention of barriers or their resolutions.

Team Composition:

Does the lead principal investigator have successful management history and experience leading collaborative teams? Is it clear that all key personnel are committed to making significant contributions to the project? Do team members have complementary skills?

adequate
The team is focused, multi−institutional, and come from similar disciplinary backgrounds (toxicology, water quality). The roles/tasks are defined and personnel are committed. Skills are complementary.

Communication Of Results:

Is there a clear plan for comprehensive and cohesive reporting of project progress to the CALFED community?

inadequate
The presentation of results are not articulated beyond normal expectations (poster, oral presentation, journal article).

Additional Comments:

Collaboration Panel (Discussion) Review

Primary judges communication of results as adequate, but considers the proposal as not exceptional. There were no extensive details on the required criteria, other than the lab work.

Secondary agrees with all of primary reviewer's comments.

Technical Synthesis Panel Review

Proposal Title

#0122: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Final Panel Rating
superior

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

I think that the proposal clearly lays out an extremely important problem. It appears that a relatively new and potentially very serious problem exists with blooms of Microcystis in the Delta region. This phenomenon is addressed in several of the proposals that we have to review and this one gives what appears to be the most knowledgeable account of what is known.

Additional Comments:

I think that the proposal clearly lays out an extremely important problem. It appears that a relatively new and potentially very serious problem exists with blooms of Microcystis in the Delta region. This phenomenon is addressed in several of the proposals that we have to review and this one gives what appears to be the most knowledgeable account of what is known.

Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

The proposal addresses a potentially important problem with newly occurring blooms of the cyanobacteria, Microcystis aeruginosa. Blooms of this species are a well−recognized problem in a number of fresh waters because of toxins that can have serious negative impact on ecosystems and be a threat for human health. The research team is well−qualified to conduct the proposed research, the proposal is well−designed, and the external reviews were very supportive (4 reviews with overall ratings of E, VG, E, VG). The PI, Lehman, has experience with this algal bloom and has just published a paper on the bloom in the Delta. While the study is ambitious, it builds upon her earlier studies. The panel did not feel that the minor concerns raised by the external reviewers were significant. For example, one reviewer questioned the relevance of the data collected for decision−makers; since the main PI works for a management agency, this is probably not a major concern. Although the research is not cutting−edge (the toxicity of this organism has been studied elsewhere), there is concern that the problem is a serious emerging one in the Delta. There was question from two of the reviewers regarding the extent of toxicity of the blooms; the proposed research should be able to test this further. If CBDA finds this of high priority, technical review warrants funding.

Technical Review #1

proposal title: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The goals of the project are clearly stated. They are to determine the impact of Microcystis on ecosystem structure and function and to develop monitoring and management strategies. These goals will be addressed through a three−part program consisting of literature review of toxicity studies, field program, and bioassays. Increasing attention is being devoted to harmful algal blooms (HAB's) worldwide. Investigation of a recent, recurrent bloom in the Delta ecosystem is a timely and appropriate study. The "over−arching" hypotheses are clearly stated but too general to be meaningful. I don't fault the investigators for this. I expect stronger, more provocative hypotheses will result after the literature review and initial sampling. The table that lists questions and approaches to the answers is a strong point of this proposal.**
Rating	**excellent**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The study is justified relative to existing knowledge. The conceptual models presented indicate the investigators have performed background investigation and preparation before submitting the proposal. Most analyses of field samples are conventional and use well-established methods. The procedures for the toxicity analyses appear to be straightforward. The facility for the fish bioassays exists and the investigators have demonstrated they can successfully maintain Splittail over the duration of the proposed experiment.**
Rating	**excellent**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**The approach is well-designed and appropriate for meeting the goals of the project. The analyses of nutrients and other water quality parameters are routine. The attempt to relate the occurrence of Microcystis blooms to physical factors (e.g. residence time, stability) has been done before in other systems. The water quality monitoring and analyses may be necessary to establish conditions in the Delta but nothing novel is likely to result. The strong points of this proposal are the toxicity analyses and the bioassays. A lengthy history of monitoring Microcystis blooms exists and their effect on conventional water quality (e.g. light attenuation) is well known. In contrast, much less information exists on the toxic nature of these blooms and on the pathways the toxins take through the ecosystem.**
Rating	**excellent**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**The approach is well documented and is feasible. As noted previously, most of the proposed methodology exists and the investigators are experienced in their proposed roles.**
Rating	**excellent**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**A large portion of this investigation is devoted to monitoring. The methodology is well documented, especially in the less−conventional areas of toxicity analyses and bioassays. The proposal notes that a quality assurance plan will be developed. All data will be entered into a database that is accessible to the public, government and stakeholders.**
Rating	**excellent**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**Products of value are likely to result from this project. The most valuable product will be knowledge. Especially valuable insight into the nature and pathways of HAB toxins will be gained. The investigators may also add to the existing body of knowledge on environmental factors that contribute to**

	Microcystis blooms. Tangible products include the distribution of the literature review through a web site, contribution of all data to a public data base, multiple project reports, and journal contributions.
Rating	**excellent**

Additional Comments

Comments	**One aspect of this proposal puzzles me. On page 15, the chlorophyll concentration of the largest Microcystis colonies is stated to be 0.075 micro gm/L (October 2003). This isn't much of a bloom at all. Microcystis chlorophyll concentrations of several hundred micro gm/L have been observed in the Potomac River. Algal assays indicate more than 1.5 mg/L Microcystis carbon in the St. Johns River, Florida. This converts to roughly 50 micro gm/L chlorophyll. Is there a misprint with the reported value in the Delta? Was the bloom over by October? Was there some specific sampling methodology that resulted in the low reported chlorophyll in the Delta? I tried to check on the reported value for the Delta but the Hydrobiologia article is not yet available.**

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The authors have a good track record. The principal investigator has previous experience in the Delta and has published articles relating long-term changes in chlorophyll to environmental factors. The investigators involved with toxicity and bioassays are experienced in their area. I am encouraged that the facility for the fish bioassays exists and that the**

	ability to maintain Splittail has been established.
Rating	**excellent**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The project budget is reasonable for the proposed work. Salaries are in line with standards in the field. Overhead rates are low compared to rates elsewhere. Most equipment and facilities for the study already exist. Costs for laboratory analyses are reasonable, especially considering the complexity of the toxicity analyses.**
Rating	**excellent**

Overall

Provide a brief explanation of your summary rating.

Comments	**HAB's are of current interest nationwide and worldwide. The investigators are qualified to conduct the proposed investigation. The toxicity and bioassays are especially valuable. Costs are reasonable.**
Rating	**excellent**

Technical Review #2

proposal title: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The goals of this study are to investigate the extent of a new HAB species in the Sacramento−San Joaquin Delta, Microcystis aeruginosa. This is a potentially dangerous alga from both a human health and environmental impact standpoint, and it appears that relatively little is known about this species, which first appeared in 1999. I would think this would be a high priority issue because of the potential risk to human health and to wildlife.**
Rating	**excellent**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**One problem with this proposed study is that virtually nothing is known about the extent and distribution of this potentially harmful species. Limited study has benn carried out by the authors of this proposal. So, because of the novelty of this problem, it is difficult to justify on existing knowledge, because existing knowledge is so limited. The concetual model is clearly stated, and well based on other studies of**

	harmful algal blooms in general and blue-green algal blooms more specifically. The need for the literature review (task 1) and the moitoring program (task 2) and clearly well justified. Task 3, the fish toxicity study, could be less well justified if task 2 demonstrates that this species is rare and reaches harmful densities on limited spatial or temporal scales.
Rating	**very good**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**The approaches for tasks 2 and 3, the field and laboratory studies, seemed appropriate, although the methods were not always explained as thouroughly as I would have liked. I assume this authors have experience with these types of studies, and simply failed to provide adequate details in some cases.**
Rating	**good**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**The tasks outlined in this proposal are well documented and technically straightforward. The quantification of microcystin toxins is technically challenging, but they are collaborating with one of the best labs in the nation on this task. I think the likihood of successfully carrying the proposed work is very high, although until it is done and the extent of**

	this toxic alga is known, it will not be possible to know how significant their findings could be. For example, it is always possible that the project will be funded, and no Microcystis will be found.
Rating	**good**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	Monitoring is the key to task 2, and the plan seems appropriate. Exact details are not given on the stations to be sampled or the sampling design; the authors will adjust this when they learn more through preliminary field work. Statistical tests for analysis of data are only mentioned in broad terms.
Rating	**good**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	This is a somewhat high risk project. If extensive Microcystis populations are found, and toxins are measured in ecosystem components, the findings from this study will be of great value. If it is found that this alga is rarely present or absent during the study period, the results will be of less value.
Rating	**good**

Additional Comments

Comments

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**Although I am not familiar with any of the authors by reputation (other than Boyer, who will measure the toxins), I was impressed with their publication records. These are all active scientists with good credentials and publications. Based on past performance, I expect they can easily carry out the project they have proposed here. They appear to have the experience and equipment necessary to complete the proposed research.**
Rating	**very good**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The budget seems reasonable and adequate for the proposed work. It is interesting to note that the boat operator receives the same hourly wage as the PI. Only in state government!?!**
Rating	**very good**

Overall

Provide a brief explanation of your summary rating.

Comments	**Overall, I would rate this proposal very highly. This is an issue that needs to be investigated. As I mentioned before, it is somewhat high risk, given the lack of knowledge on this blue green alga in this**

	system. If it is not present during the study period, little will be learned. If funds were limited, task 3 seems the lowest priority to me until more is known about the extent of the problem.
Rating	**very good**

Technical Review #3

proposal title: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**Goals and a series of hypotheses are clearly stated and internally consistent. Objectives are expressed in the form of clearly−framed questions to be addressed by the study. I had no problem understanding the purpose of this study to examine the importance of a toxic cyanobacterium in the Sacramento−San Joaquin Delta.**
Rating	**excellent**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The study certainly seems justified. A bloom of a toxic cyanobacterium appeared in the Delta in 1999 and has persisted since then. Toxins produced by this alga can impact the estuarine food web, and potentially impact human health. The proposal is convincing that this is a serious environmental problem that needs to be better documented and understood.**
Rating	**excellent**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**The approach is well-conceived and feasible. For the most part, the methods of sampling are fairly standard. Water chemical analyses will be performed by an EPA lab. The histopathology and fish bioassay work also are described clearly. The information should be immediately helpful to decision makers, and contribute to the scientific literature.**
Rating	**excellent**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**For the most part, the approach is well-documented and technically feasible, with one notable exception. The authors state on page 3 that "special sampling techniques" are necessary for collection of Microcystis. But neither in the text nor Table 1 could I find a description of the techniques to be used for collection of any algae, including Microcystis. I also could not find a description of the method to be used to distinguish Microcystis from co-occurring phytoplankton. Presumably, this will be done by microscopy, or perhaps chromatography. Lack of explanation of these techniques is probably a simple oversight, as the authors do have prior experience working with these algae.** **Overall, I think the project does have a good chance of success and is designed at an appropriate scale for the questions posed.**

Rating	**very good**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**Monitoring is a major part of this project. Pre−Post comparisons of the algal community and physicochemical conditions of the estuary will be made by reference to historical data sets. These data are available from the Historical Estuarine Monitoring Program and the Interagency Ecological Program. The proposed monitoring design will generate data to be compared with the historical data.**
Rating	**excellent**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**First, the project will establish a literature database on human and aquatic health impacts of the toxin−producing alga Microcystis. Apparently, there is not a website of this kind available at present (which is a bit surprising). The monitoring data compiled during this project, especially when compared to the historical dataset, should be very interesting and useful for decision makers. Results of tissue analyses of plankton and benthos for microcystins will reveal the extent to which these toxins are present in the foodweb. The proposed fish bioassay to determine potential chronic impacts of microcystin on splittail is an important component of the project.**
Rating	**excellent**

Additional Comments

Comments

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The authors make a good team, and includes a biologist, a chemist, and a pathologist. Their publication record suggests they know how to get things accomplished. The infrastructure to carry out the work is available.**
Rating	**excellent**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The budget seems reasonable and adequate.**
Rating	**excellent**

Overall

Provide a brief explanation of your summary rating.

Comments	**This is an important project to document the extent of Microcystis development in the Sacramento–San Joaquin Delta. The project combines analysis of historical data with contemporary monitoring of water quality, toxicity levels in animals, and the phytoplankton community. In addition, the authors will study the effects of Microcystis toxin ingestion by fish. These approaches are complementary, and together will provide data directly and immediately useful to environmental managers. The team is very good and has the capabilities to accomplish the objectives of this**

	study.
Rating	excellent

Technical Review #4

proposal title: Biomass and toxicity of a newly established bloom of the cyanobacteria Microcystis aeruginosa and its potential impact on beneficial use in the Sacramento−San Joaquin Delta

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**There are two overarching stated goals. 1. Determine the impact of a newly established toxic cyanobacterium on ecosystem structure and function, as well as human and wildlife health. 2. Based on information obtained make recommendations for developing a monitoring program, as well as provide information for development of management strategies. These goals will be achieved through a 3 yr field and laboratory research program that focuses on distribution, biomass, toxicity, human and wildlife health risks and ecosystem impacts.** **There are two over−arching hypotheses: 1. Organic carbon and toxicity associated with the bloom changed ecosystem structure and function and poses a continuing health threat to humans and wildlife, and will interfere with restoration efforts in the Delta. 2. Information on spatial and temporal variation of the bloom carbon, its toxicity and toxic pathways in the food web can be used to reduce or manage the harmful impacts of the bloom.** **The following questions are proposed to be addressed to support the hypotheses. 1. When and where are the bloom biomass and toxicity**

	highest 2. How toxic is the bloom to humans and aquatic wildlife on acute and chronic time scales 3. Is the biomass or toxicity increasing over time 4. What environmental factors control bloom development 5. How prevalent is the occurrence of Microcystis toxins in the food web 6. What are the trophic pathways for Microcystis toxins 7. What is the primary source of the bloom 8. How could the bloom be controlled or reduced 9. What is the best way to sample and monitor the bloom. **There are then three tasks: 1. Literature review to obtain information on acute and chronic effects of toxins on humans and wildlife. Determine health risk associated with current toxicity and bloom biomass. Identify possible management strategies. 2. Three year field program and historical data analysis with the following components: a. Spatial and temporal variability in bloom biomass and toxicity b. Environmental conditions that influence bloom biomass and toxicity c. Assessment of Microcystis toxins in the food web d. Pathways of toxin transfer in the food web e. Historical data analysis to I) reveal factors that contributed to bloom initiation and development ii) identify any apparent impacts on biological communities and water quality. 3. Fish bioassay to test potential chronic impact of Microcystis toxins to fish health and survival at various levels as well as those currently in food web.** **Clearly, there are many different components to the proposed work. All of the goals, objectives and hypotheses are headed in the same direction, but would benefit from being presented in a more cohesive and concise fashion. Overall, the proposed project is considered to be both timely and important.**

Rating	**good**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The PI's have clearly identified the CALFED program goals that the proposed work would contribute to. This justification, by in large, seems valid with the exception of how the proposed work would contribute to "Water storage and use efficiency goals to manage water in wildlife areas and provide reliable good quality water through storage programs…" The need for additional research on Microcystis in the Delta is well justified by the PI's. However, the proposal would be strengthened if the literature review that has been proposed had been carried out and used as part of the existing knowledge in this proposal rather than to have it included as a task of the proposed work.** **The PI's have presented a suite of conceptual models they will modify as they obtain results. These models seem to be a good starting point. It would have been useful for the PI's to describe the process by which the data they collect will be integrated into these models.**
Rating	**very good**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**The overall approach addressing the project objectives via field studies of Microcystis biomass, toxicity, food web transfer, historical data analysis and fish bioassays seems in general to be well thought out and appropriate. The approach does not require new technique development and therefore is certainly feasible. The results obtained from the proposed work will definitely add to the current base of knowledge. Also the work should result in the identification of an optimized monitoring program for Microcystis. It is unclear from the proposal exactly how decision makers will use the data, although it will be disseminated to them through reports, databases and other means.**
Rating	**very good**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**The approach that has been presented is technically feasible and the sampling strategy for year 1 has been well described. However, it is indicated that the "sampling regime will be adaptively managed over the remaining sampling periods (yrs 2 &3) to best address the hypotheses". While it is understandable that there should be some latitude to adapt the sampling based on results obtained in year 1, it would have been beneficial if the PI's included at least a minimal level of sampling that would be carried out in subsequent years.** **Based on the qualifications of the PI's and the utilization of established methodologies there should not be any technical complications in carrying out the proposed work. However, the scale of the project is viewed as overly ambitious. In particular it seems that the scope of proposed work to be carried out in Task 2 will be difficult to complete given all of the different components of this task. The number of**

	questions that are being asked (as indicated in Table 1) are likely to be difficult to address in a meaningful way. It might be better to focus greater attention on a subset of these questions.
Rating	**good**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**The PI's have put substantial thought into the monitoring design including criteria for station selection, particularly for year one. One potential concern however, is that it is indicated the stations will represent a broad spectrum of habitats including 6 different types. If there are 6 different habitat types and there will only be 9 selected stations, will this provide enough data on each habitat type for meaningful statistical analyses? Would it be better to have multiple stations of fewer habitat types?** **The PI's have done a good job at indicating for each task and activity the method that will be used for the data analysis.**
Rating	**very good**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**The products from this research project are to include the following: 1. An Interagency Ecological Program BDAT database containing**

	field and laboratory data as well as a Meta database where applicable. 2. A literature database on the OEHHA website related to Task 1, which will be linked to the Interagency Ecological Program. 3. At least three peer reviewed journal articles will be submitted. 4. Results will also be presented at appropriate scientific meetings and conferences. **A product that is missing from this list is one that links the data collected directly with the development of long-term restoration management strategies.**
Rating	**very good**

Additional Comments

Comments	**The project task section indicates that the Fish Bioassay will be carried out for three years, but the budget and project description has this being carried out primarily in year 1, with perhaps some data analysis in year 2.**

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**Dr. Lehman brings expertise on phytoplankton and water quality in the Delta. She currently has an article on Microcystis in the Delta listed as being in press (Hydrobiologia). She has been awarded significant CALFED funding in the past (ending 2001) for a dissolved oxygen study in the San Joaquin River. Only selected journal publications were included in her C.V. so the level of productivity from that prior funding is not possible to assess. Nevertheless, she brings considerable strength to the proposed project. Dr. Washburn is an aquatic toxicologist with expertise**

	in natural toxins. She has published approximately one journal article per year with the most recent publication being an Internet watershed assessment manual. Dr. Boyer brings expertise on cyanobacterial toxicity and has a strong publication record. He and Dr. Lehman have a co−authored publication in press, so it is clear they have an already established collaboration that will be beneficial for the proposed project. Dr. Teh brings expertise on Delta native fish toxicity bioassays to the project and has a strong publication record. **Overall, the qualifications of the project team are very good to carry out the proposed work.** **Only the facilities at U.C. Davis were described so it is not possible to fully assess the infrastructure at the other locations for carrying out the proposed work. At U.C. Davis the infrastructure for carrying out the project is excellent.**
Rating	**very good**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**I believe there are some mistakes in the budget. For example in one instance (Task 2a) Lehman, Peggy is listed for 1848 hrs @ $41.87 per hour. This amount is calculated as $82,903. I think this equals $ 77,375 (unless there is some percentage raise included for each year). Next, her Technical Assistant is listed as being paid at the same rate $41.87 per hr. Is this correct? Also is the boat operator paid $41.87 per hr? The number of hours for the boat operator does not equal the number of days for the boat operation unless these are 11 hr work days for the boat driver.** **In any event the budget should be gone over carefully to determine possible errors. Overall the budget for**

	the project seems a bit high.
Rating	**good**

Overall

Provide a brief explanation of your summary rating.

Comments	**The proposed work is very ambitious with three major project components. The PI's are well qualified to carry out the proposed work. I have no doubt that there could be significant accomplishments towards the overall goals. Nevertheless, the proposal would have benefited from being more focused on fewer questions, with better linkages back to the over−arching hypotheses. The proposed work is likely to obtain critical information to make recommendations for developing an appropriate monitoring program, however it falls short in identification of the " use this information for development of effective management strategies".**
Rating	**very good**